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Critical Mineral Security and its Role in Greener Technologies

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ABSTRACT

Critical minerals are indispensable for the global transition towards greener technologies, including the production of solar panels, electric vehicles, wind turbines, and advanced batteries. These minerals, such as lithium, cobalt, and rare earth elements, are essential for the economic health and technological advancement of nations. However, their supply is often limited due to factors like geopolitical tensions, geological scarcity, and trade restrictions, making their security a national priority. This paper explores the concept of critical minerals, the criteria that determine their 'criticality,' and their pivotal role in fostering sustainable technologies. It also delves into the challenges faced in securing these minerals, such as inadequate geological availability and socio-environmental issues. India, despite being mineral-rich, is heavily dependent on imports for its critical mineral needs, making the establishment of a comprehensive legal framework essential. The paper advocates for a robust strategy that includes increased exploration, research and development, and international collaborations to ensure the long-term availability and security of critical minerals. A call for legislation to regulate critical mineral security in India is emphasized, addressing stockpiling, accounting, auditing, and international partnerships, thus ensuring the country's mineral security and its role in the global green technology revolution.

Keywords*: Minerals, green, environment, technology, geological.*

I. INTRODUCTION

India is one of the top mineral-producing countries in the world, next to China, Australia, the United States of America and Russia with 77 Billion Dollars in mineral production value.[3] India is a mineral-rich country and is the home to abundant mineral wealth producing 84 minerals including 4 fuel, 11 metallic, 49 non-metallic industrial and 20 minor minerals.[4] India has the 5th largest coal reserves in the world. It is the 4th largest producer of iron ore and 3rd in rank in

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[3] Staista, (2020), *Leading mining countries worldwide in 2016, based on mineral production value (in billion U.S.Dollars)* (Bar Graph/Chart) https://www.statista.com/statistics/1114898/leading-mining-countries-worldwide-based-mineral-production-value/ (last visited on Dec.15, 2020).
[4] TERI, *Overview of Mining and Mineral Industry in India*, TATA Energy Research Institute, (2001) https://pubs.iied.org/pdfs/G00615.pdf (last visited on Nov 18, 2020).

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producing aluminium. It ranks 5th in its bauxite and zinc production and 3rd in producing limestone and chromite. It is the 2nd largest producer of steel. Minerals play a significant role in our day-to-day lives. The minerals have such a significant history throughout the world that various periods are known by the names of the minerals, starting from the Stone Age to Copper Age, Iron Age to Atomic Age.[5] Minerals are the bedrock of the industrial sector due to their use as raw materials in the manufacturing industries.[6] Mining of minerals is so interwoven with mankind and money, that without mining there won't be any minerals and without minerals, industrial progress is not possible and without progress, mankind has no meaning worth the name.[7] Thus, the development of mines and minerals is integral not just to the progress of the industrial sector and mankind but also to the economic workings of our country.

"The real wealth of the Nation lies in the resources of the earth – soil, water, forests, minerals, and wildlife." ---Rachel Carson. Just like how water, forests and wildlife are conserved against its scarcity, minerals also need to be secure to have for the future demand and supply. Mineral security means the sufficient availability of mineral resources that are feasible and have the expected quality despite serious situations like severe global competition in the international market, hurdles in the import of minerals from countries which has abundant mineral wealth, and poor economy.[8] The need for mineral security arises from the steady global population expansion and explosion as the demand for minerals increases with the increase and expansion of population which in turn results in the threat of future mineral scarcity.[9]

The focus of this paper is to understand the meaning of the term Critical Minerals and try to establish the need for such Critical Mineral security. The paper also deliberates on how a mineral attains the status of Critical minerals by determining the criteria for 'criticality'. This paper also brings the importance of the role played by critical minerals in the greener technologies and its significance in contributing towards the national economy. This paper also states the need for a legal framework governing Critical Mineral Security in India.

II. CRITICAL MINERALS

Minerals are many but there is no standard list of critical minerals. It differs from state to state. What is considered a critical mineral by one state will not be so critical in another state. Similarly, a mineral that is considered as critical mineral in one industry will not be so critical

[5] D.D. SETH, ENCYCLOPAEDIA OF MINING LAWS (7th ed. 2020).
[6] TERI, *supra* note 4.
[7] *supra* note 5.
[8] Geography Revision, *Mineral Security*, https://geography-revision.co.uk/a-level/human/mineral-security/ (last visited on Dec.15, 2020).
[9] *Id.*

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in another industry. Critical minerals are understood to be metal and non-metals which are considered crucial for the economic health of emerging economies and the world's major economies but are considered to have supply risk due to factors such as trade policy, geological scarcity, geopolitics involved and other factors.[10] In India, the term 'critical minerals' was mentioned in the Defence Science Journal in 1952 based on Dr. D.N. Wadia's speech made at the 2nd Defence Science Conference on 23rd April 1952. According to the article in Defence Science Journal, *"Critical Minerals are minerals of essential uses, the supply and procurement of which in adequate amount in the event of national emergency is uncertain".*[11] Critical minerals and strategic minerals are sometimes used interchangeably. However, there is a slight distinction between the two which is the relevance that critical minerals have for the overall interests of the state while strategic minerals have relevance for the national security and defence of the state.[12] It is the geographical availability and the availability of domestic supply that determines the critical nature of minerals in any state country or region.[13] There is a high possibility that the treatment of the supply of critical minerals would cause harm to the economy of the country. In other words, a critical mineral may or may not be a strategic mineral but a strategic mineral will always remain a critical mineral.[14] It essentially means that the term 'critical minerals' is much wider than the term 'strategic mineral'. Such critical minerals are mostly used in the manufacturing industries like in the manufacture of solar panels, smartphones, flat-screen televisions and monitors and various other high-tech technologies and applications.[15]

III. ROLE OF CRITICAL MINERALS IN GREENER TECHNOLOGIES

The change in approach from fossil fuel to green technology and green environment results in the need for the production of numerous amounts of solar panels, electric vehicles, wind turbines and batteries. The demand for such green technology and green environment will escalate the demand for minerals that are required to produce them.[16] Some of the critical

[10] Australian Government Geoscience Australia, *Critical Minerals*, https://www.ga.gov.au/about/projects/resources/critical-minerals#:~:text=Critical%20minerals%20are%20metals%20and,trade%20policy%20or%20other%20factors (last visited on Feb.12, 2021).

[11] Dr.D.N.Wadia, *Strategic Minerals of India*, 2(4) DEFENCE SCIENCE JOURNAL 198 (1952).

[12] Ajay Lele, *India's Need for Strategic Minerals*, 2 (2) NATIONAL SECURITY: VIVEKANANDA INTERNATIONAL FOUNDATION 247 (2019).

[13] Mike Luft, *What are strategic Minerals?*, MINING FEEDS (Aug. 2, 2011) https://www.miningfeeds.com/2011/08/02/critical-mineral-companies (last visited on Feb.12, 2021).

[14] Virginia T. McLemore, *Geology and Economics of Strategic and critical minerals*, https://geoinfo.nmt.edu/staff/mclemore/teaching/documents/Introduction.pdf (last visited on Feb.15, 2021).

[15] Australian Government, *supra* note 8.

[16] Bénédicte Cenki-Tok, *Critical Minerals are vital for renewable energy. We must learn to mine them responsibly*, THE CONVERSATION (Feb.17, 2020) https://theconversation.com/critical-minerals-are-vital-for-renewable-energy-

minerals that are required for greener technologies are rare-earth elements, gallium, lithium, tungsten, chromium, manganese, molybdenum, cobalt, nickel, palladium, platinum etc.[17] Critical minerals like indium, selenium, lithium, silicon, platinum, cobalt, arsenic, nickel, silver, germanium etc are used in energy technologies for producing thermal solar power, electricity, solar photovoltaic, wind power and hybrid and electric vehicles.[18] It is also used in electronics and for lighting purposes. Manganese, cobalt, lithium and graphite are critical minerals which are used in technology involving battery.[19] Minerals such as vanadium, terbium, rhenium, nickel, cobalt, europium etc are used by communications, aerospace and defence sector for utilising it in drones, fighter jets, radios, tanks, shielding and other combat equipment.[20]

The constraints faced by these critical minerals while moving towards greener technologies include inadequate geological availability, dependence on by-products, technical and technological constraints, lack of available economically minable resources, socio-environmental issues restricting long-term availability and long-term sustainability of mining of critical minerals and inadequate mineral beneficiation. [21]

IV. CRITICAL MINERAL SECURITY

Since critical minerals are those minerals that are affected by supply risk, economic risk and adequate availability during a national emergency, they must be secured and stockpiled. The word 'critical' by itself gives rise to the need for such resource security. The most critical question that arises is which minerals are treated as critical minerals and based on which criteria. In essential, what is the criterion which determines the 'criticality' of minerals? It all depends on various factors such as the length of supply (short or long supply), cost, controls and utility factors. Other factors based on which the 'criticality' is conferred are whether the nation-state is proficient in technology and has the required financial investments. Also, there are mineral-rich and mineral-deficient nation-states. Based on the nature of mineral deposits of a particular nation-state, the criticality and strategic importance of minerals are being fixed. The study conducted by the Department of Science and Technology (DST) and Council on Energy,

we-must-learn-to-mine-them-responsibly-131547 (last visited on Feb.20, 2021).

[17] Australian Government, *supra* note 13.

[18] Society for Mining, Metallurgy and Exploration, *Critical and Strategic Minerals: Importance to U.S.Economy*, https://www.smenet.org/What-We-Do/Technical-Briefings/Critical-and-Strategic-Minerals-Importance-to-the (last visited on Feb.20, 2021).

[19] *Id.*

[20] *Id.*

[21] Arpita Khanna and Swati Ganeshan, *Critical Non-Fuel Minerals Security: Why India urgently needs to have a policy in place*, TERI POLICY BRIEF (Dec, 2010) https://www.researchgate.net/publication/340967067_Critical_non-fuel_minerals_security_Why_India_urgently_needs_to_have_a_policy_in_place (last visited on Feb.14, 2021).

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Environment and Water (CEEW) in 2016 identifies two criteria for assessing and evaluating the 'criticality' of minerals, namely, economic importance and supply risks.[22] The term economic importance here refers to the total score received from the distribution of mineral usage across various sectors and industries with different economic importance.[23] The basis for supply risk is the lack of availability of critical minerals. This issue of availability takes five dimensions, namely,[24]

1. Geological availability
2. Technical availability
3. Environmental and social availability
4. Political availability
5. Economic availability

The supply risks faced by critical minerals drive studies and research towards identifying the substitutability of critical minerals and the recycling potential of such critical minerals. The DT CEEW (2016) study identifies 49 minerals that are at present and in future would be critical by classifying them into three categories, namely, most critical, moderately critical and least critical based on their high or low economic importance and high or low supply risk.[25]

V. LEGAL FRAMEWORK GOVERNING CRITICAL MINERAL SECURITY AND THE NEED FOR LEGISLATION

In India, the National Mineral Policy, 2019 emphasises the economic and strategic importance of mineral resources security. It states that the functioning of the overall economy and downstream industries is increasingly becoming dependent on the core factor of securing access to affordable, reliable, adequate and sustainable minerals. The policy also declares it a top priority to ensure long-term mineral security for the country. The government shall align downstream regulations for the exploration and development of minerals that are unavailable domestically to ensure a sufficient supply of such minerals and to facilitate the acquisition of mineral assets by public and private Indian business entities in other countries.[26] In 2016, the National Exploration Policy was launched which provided for biennial update by the Indian

[22] Vaibhav Gupta et al, *Critical Non-Fuel Mineral Resources for India's Manufacturing sector: A Vision for 2030,* DST CEEW (Jul.19, 2016) https://dst.gov.in/sites/default/files/CEEW_0.pdf (last visited on Feb.17, 2021).
[23] *Id.*
[24] National Research Council. *Minerals, Critical Minerals, and the U.S. Economy*. WASHINGTON, DC: THE NATIONAL ACADEMIES PRESS (2008) https://doi.org/10.17226/12034 (last visited on Dec.29, 2020).
[25] Gupta et al, *supra* note 22.
[26] National Mineral Policy, 2019

Bureau of Mines in the database for the country's requirements for strategic and critical minerals based on global and domestic supply and demand this data from the database would be used to prioritize the exploration of strategic and critical minerals.[27]

Khanij Bidesh India Limited (KABIL) was formed in 2019 for the exploration of strategic and critical minerals and other overseas mineral assets to strengthen the nation's mineral security. To explore, identify, acquire, develop process mine and sell critical, strategic and other overseas minerals for both the purpose of securing minerals and commercial use KABIL ensures India's mineral security by way of the supply side of energy minerals.[28] It has commenced engagement with Argentina, Bolivia, Russia, Chile and Australia with federal agencies of respective states and with state-owned and central public enterprises.[29] Recently India has signed a MOU with Argentina, ie., KABIL with M/s. YPF of Argentina and M/s. Jemse of Jujuy Province of Argentina, for sharing information on scientific-technological development and commercial purposes in the field of Lithium Deposits in response to the geopolitical strategy of China in capturing and acquiring key critical minerals.[30] India has also signed a joint deal with Australia to get lithium supply from Australia to provide for the 'Make in India' programme and to develop the space and defence industry.[31]

These are some of the policies and actions taken by India towards securing critical minerals. Despite such an active role in securing critical minerals, there is much more yet to be done for India to be dispensed with worry over critical minerals. India's mineral policy has taken steps only towards the exploration of strategic and critical minerals. Even with exploration more active participation is required for such activities to cover the vast mineral-rich area in India. India allows 100% foreign investment through an automatic route. Though this would encourage foreign investment, there is a risk of exploitation of strategic and critical minerals by foreign enterprises. Hence, it is not advisable to have 100% FDI in the mining sector when the country is deficient in certain strategic and critical minerals. in addition to exploration activities, institutional reforms must be made in a step towards an organised way of securing critical minerals. Moreover, research and development must be taken up to identify substitutes for

[27] National Mineral Exploration Policy, 2016, Clause 7(iii).
[28] Indian Bureau of Mines, *Indian Mineral Industry and Nayional Economy*, Indian Minerals Yearbook 2019 (Advance Release) https://ibm.gov.in/writereaddata/files/02052021174302IMINE_2019.pdf (last visited on Feb.19, 2021).
[29] *Id.*
[30] Huma Siddique, *South-South Co-operation: India and Argentina ink a strategic agreement on Lithium*, FINANCIAL EXPRESS (Jul.19, 2020) https://www.financialexpress.com/defence/south-south-co-operation-india-and-argentina-ink-a-strategic-agreement-on-lithium/2022246/ (last visited on Feb.18, 2021).
[31] Reuters, *Australia and India sign joint deal on critical minerals like Lithium*, ECONOMIC TIMES (Jun.5, 2020) https://auto.economictimes.indiatimes.com/news/auto-components/australia-and-india-sign-joint-deal-on-critical-minerals-like-lithium/76208707 (last visited on Feb.17, 2021).

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critical minerals and secure them and also to dwell into the issue of recyclability and reusing potential of critical minerals. international Interventions such as diplomatic ties and the acquisition of mining rights overseas are also another way of securing critical minerals. Though efforts through joint deals and diplomatic ties are being made, more and more action is required promptly. Although India has some policies recognising the need for mineral security and exploration of critical minerals, there is no specific critical minerals strategy like in the USA which has had a Critical Mineral strategy since 2003. Therefore, law regulating critical and strategic minerals security is very much the need. It shall contain provisions on accounting and auditing of critical minerals, maintenance of database, stockpiling, and coordination between different agencies and departments in securing critical minerals.

VI. CONCLUSION

Minerals have strategic and critical importance regardless of economic importance. It is essential to secure critical as well as strategic minerals in case of national emergency or war as most wars have been fought for resources throughout history. Critical minerals play an important role in the shift towards greener technologies from being based on fossil fuels. The 'criticality' of minerals is determined based on their economic importance in various sectors and industries and supply risk. It is said to be critical due to its inadequate availability. India faces the risk of critical mineral scarcity as it is dependent on imports for its critical mineral necessity. The solution to this scarcity is to secure the critical minerals by undertaking more and more exploration, conducting research and development for identifying substitutes, introducing institutional reforms, and maintaining diplomatic ties and joint partnerships with countries in securing mining rights overseas. There is also a necessity to understand economics related to the end-use consumption and supply quantification of such minerals. Hence, what is required is a comprehensive piece of legislation containing all aspects of critical mineral security from stockpiling and its storage and use, to accounting, auditing etc. To conclude, the ancient Tamil phrase "*கற்போம் கற்பிப்போம், கற்றதை உபயோகிப்போம்*" which means "*Let's Learn and Learn more and more and we will use what we have learned*" is very much apt to depict the urgent need for legislation and action to be taken from what we have learned of the criticality of minerals and their importance.

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